



US CMS Software and Computing Project Organization

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Fermilab

DOE/NSF Baseline Review

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Brookhaven National Lab



Talk Outline

- **Project Environment and Relations**
 - ◆ Project Team and Management Structure
 - ◆ Relation to CMS and US CMS
 - ◆ Project Oversight PMG
- **Scope and Project Plan**
 - ◆ UF and CAS Scopes and Schedules
- **Management of Budget, Cost and Schedule**
 - ◆ Resource Loaded WBS and Schedule
 - ◆ Resource Allocation
 - ◆ StatementsOfWork (SOW) and MemorandaOfUnderstanding (MOU)
 - ◆ Reporting and Budget Control
 - ◆ Change Control
 - ◆ Management Reserve
- **Project Oversight and Reviewing**
- **Project Office**
 - ◆ Staffing for Project Support
- **Summary**



Project Environment

- **Very Clear Project Goals**
 - ◆ Focused on support physics analysis needs of US CMS physicist
- **Distributed Project Team**
 - ◆ Software Engineers and Physicist, Lab and University people
 - ◆ Project people clustering at FNAL, CERN, Cal
- **Diverse Project Environment**
 - ◆ Project Stakeholders from different organizations
 - US CMS and CMS
 - US Funding agencies DOE and NSF
 - US Universities and National Labs
 - US Physicists and Software Engineers
 - FNAL CD and Director
 - Common Projects in LHC program
 - CERN
- **Strong Project Organization to keep project on track**



Project Management Plan

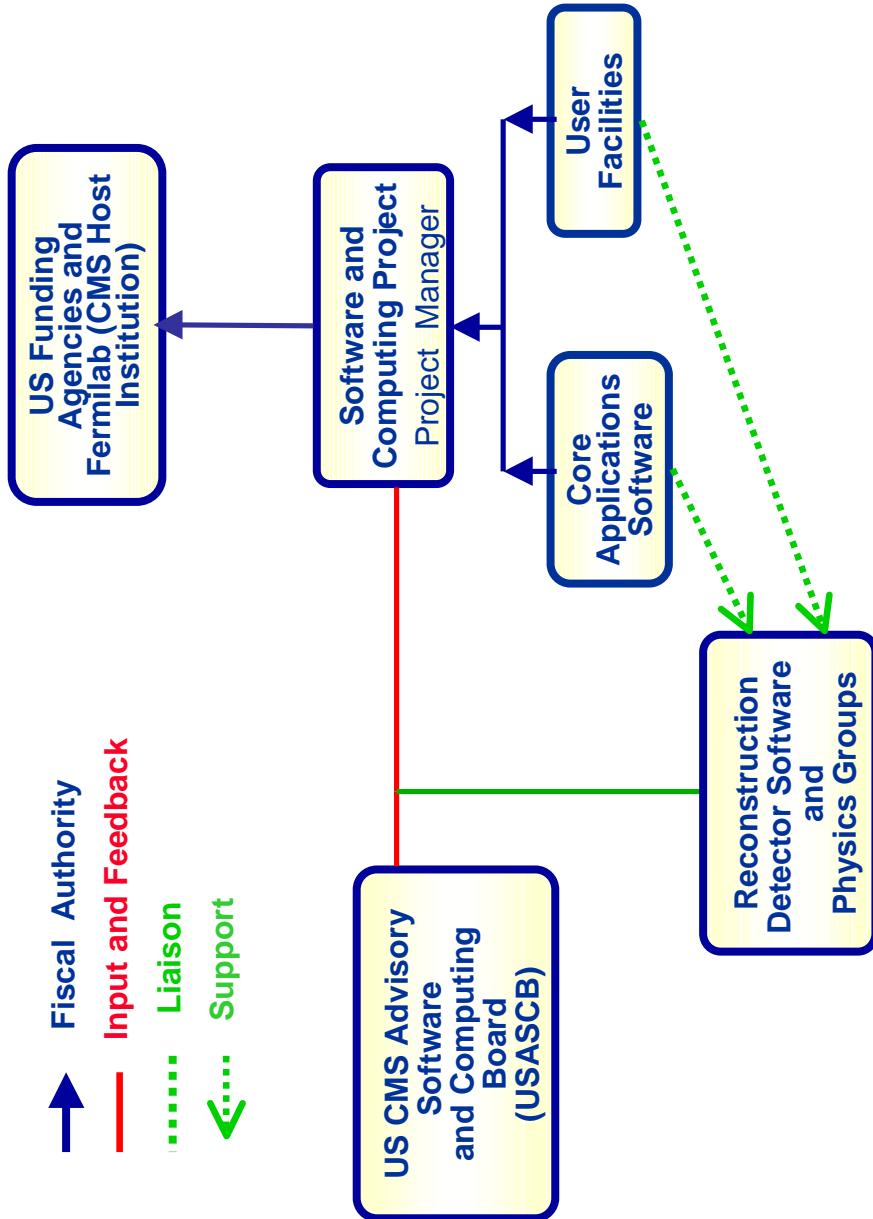
- Project is managed according to
US CMS S&C Project Management Plan (PMP)
- Approved on May 20, 2000
by US CMS Collaboration Board

► Key Management Entities

- ◆ Level 1 Project Manager
- ◆ Level 2 Project Manager
 - for Core Applications Software
 - for User Facilities
- ◆ The Fermilab Computing Division
 - ◆ The Advisory Software and Computing Board -- ASCB
 - ◆ The Fermilab Director or Designee advised by the Project Management Group (PMG)
 - ◆ US funding agencies and Joint Oversight Group (JOG)



Organization Chart





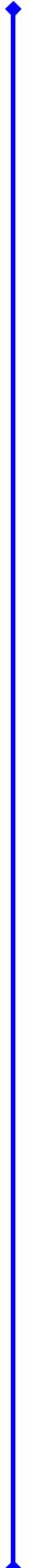
US CMS Advisory S&C Board

→ Role of the

US CMS Advisory Software and Compute Board

- ◆ The US CMS Advisory Software and Computing Board provides crucial input and feedback for the US CMS Software and Computing project. It advises the Level 1 Project Manager and provides liaison to US CMS.

- ◆ Helps in Development of the Project Plan
- ◆ Advises on Scientific and Technical Policy
- ◆ Advises on appointments
- ◆ Provides Continuous Project Input and Feedback throughout the life of the US CMS S&C Project





US CMS ASCB

► **Composition of the US CMS ASCB**

◆ **seven elected members:**

- six at large members from US CMS collaboration (elected)

Irwin Gaines (chair), Sarah Eno, Shuichi Kunori, David Stickland,
Sridhara Dasu, Paul Avery

- US CMS Physics Coordinator (Jim Branson)

◆ **seven ex-officio members**

- Chair of US CMS Collaboration Board (Harvey Newman)
- Head of Fermilab Computing Division (Matthias Kasemann)
- CMS Project Manager for Software (Marti Pimiä)
- Project Manager of US CMS Construction Project (Dan Green)
- Level 1 Project Manager (M Kasemann acting, LATB designee)
- Level 2 Project Managers for UF (Vivian O'Dell acting)
and CAS (Lucas Taylor acting)

► **US CMS ASCB is in place and actively serving its role**



Project Oversight

- **DOE and NSF as Project Sponsors have requested Fermilab to exercise management oversight**
- **This mandate vested in Fermilab Director designate**
 - ◆ Ken Stanfield, advised by Project Management Group (PMG)
 - ◆ Chair of PMG will establish subgroup of PMG for US CMS S&C
 - ◆ Subgroup chaired by Mike Shaevitz (Assoc. Director Research)
- **Project Management Group**
 - ◆ originally for US CMS Construction Project
 - ◆ PMG subgroup will have specific members added
 - including US CMS S&C L1PM, L2PMs, US ASCB chair
 - other software and computing experts
 - + US CMS CB chair, Head of Fermilab CD, others...
- **Project (through L1PM) reports to PMG for oversight**
- **Oversight in part implemented through reviews**
 - ◆ Standing Review Committee SCOP (“Blucher review”)



External Oversight Panel

- The chair of the PMG has established a standing external review committee, that will periodically examine and evaluate all aspects of the US CMS Software and Computing Project

- ◆ Members:

- Ed Blucher
- Chuck Boeheim
- Jim Branson
- Joel Butler
- Pere Mato
- Don Petravick
- Wolfgang von Rüden
- Torre Wenaus
- Univ. of Chicago
- SLAC
- UCSD
- FNAL
- CERN
- FNAL
- CERN
- BNL
- KTeV, (chair)
- IT
- CMS
- BTeV
- LHCb
- CD
- IT, (ex-officio)
- ATLAS

- First Oversight meeting held: October 23-25, 2000
- ◆ We expect to receive the report very soon



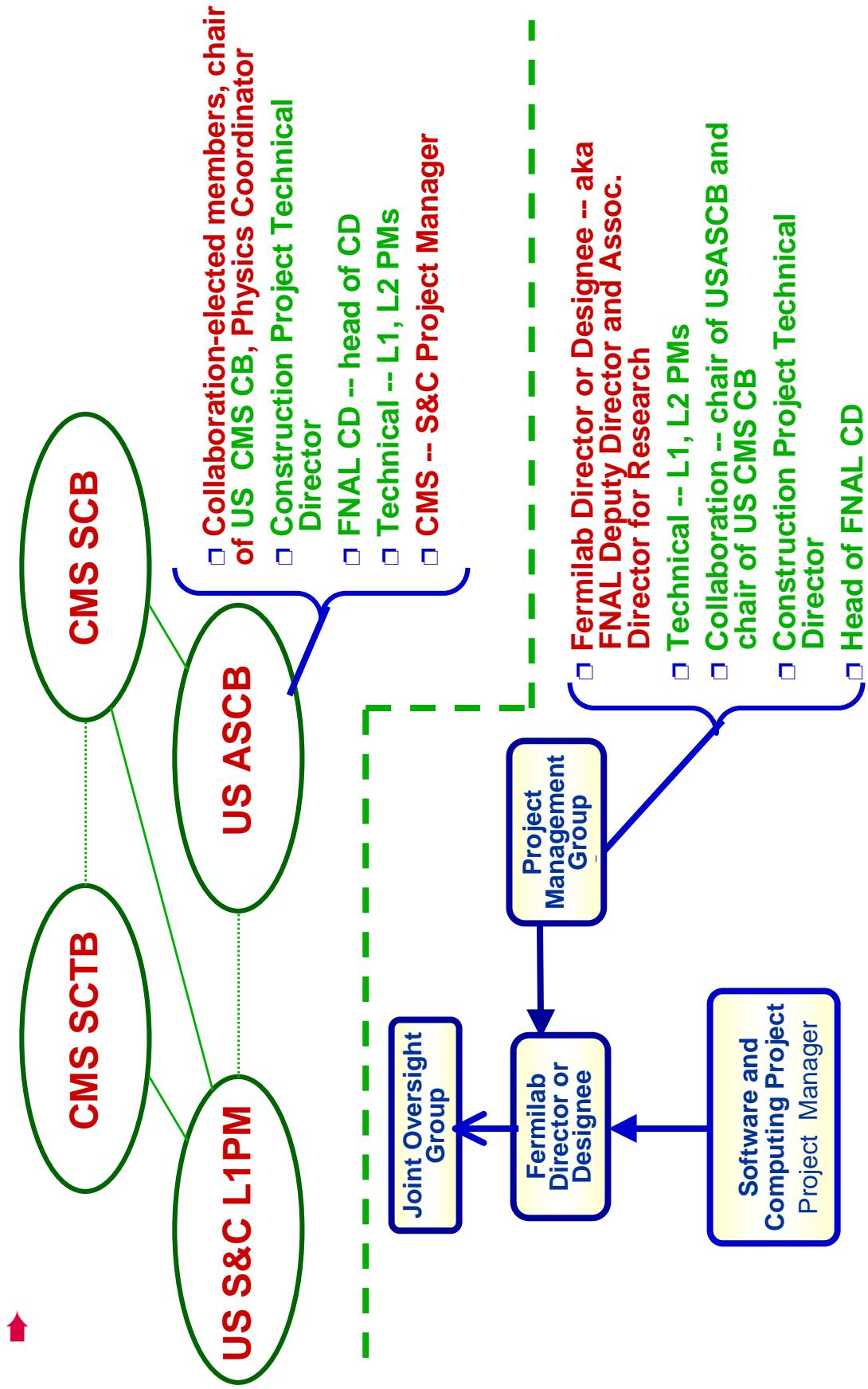
Relation to Other Entities

→ Relation to CMS

- ◆ **US CMS S&C Project is part of the CMS Core Software and Computing Project**
- ◆ **CMS L2 Manager for Software and Computing: Martti Pimiiä, deputy David Stickland/Princeton**
 - has overall responsibility for CMS Software Project, including US CMS part of it
 - is member of US ASCB (deputy is elected at large member)
- ◆ **CMS Subsystem Project Office: CMS S&C Technical Board**
 - US CMS S&C L1PM provides liaison to SCTB
- ◆ **Institutional Board for CMS S&C is the SCB**
 - US ASCB responsible for providing liaison to SCB
 - (L1PM also a member of CMS SCB for US CMS)



Lines of Communication





Formal Agreements with CMS

- US CMS will be contributing to CMS computing in a variety of ways
 - each will have an appropriate formal mechanism for establishing milestones, deliverables, and specifications.
 - support for CMS production activities, to be supported by MOUs
 - including productions to support design, testing, simulation, and commissioning of the detector
 - to be negotiated with CMS by the L1PM
 - input from the US ASCB
 - approval of the PMG and funding agencies.
 - software development directly related to international CMS
 - developed as part of the CMS software and computing plan
 - approved as part of the project plan by PMG and funding agencies.
 - software efforts specifically in support of US physicists, or to solve particular problems specific to the US
 - developed as part of the US CMS project plan
 - with substantial input from US ASCB
 - approved by the PMG and, if required, by the funding agencies.



Relation to Other Entities, cont'd

► Relation to **US CMS** and **US CMS Construction Project**

- ◆ **US CMS S&C Project** provides
 - suitable hardware and framework and infrastructure software to facilitate tasks of **US CMS** physicists all the way to physics analysis
- ◆ **CMS experiment unified enterprise, Construction and Software & Computing Projects** will be well coordinated to meet needs of **US CMS** physicists
 - for building and commissioning detector elements
 - for building software and production systems
 - for physics analysis
- ◆ **US CMS Construction Project Manager** member of **US ASCB**
- ◆ **US CMS Collaboration Board Chair** member of **US ASCB**



Relation to Other Entities, cont'd

→ Relation to US Funding Agencies

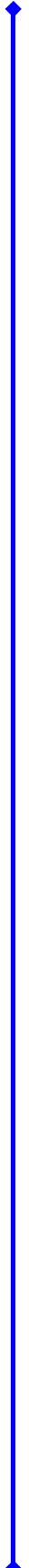
- ◆ DOE and NSF as funding agencies monitor project technical, schedule, cost, and management performance
- ◆ DOE and NSF delegated responsibility for US CMS Project to
 - DOE Office of Science, Division of High Energy Physics
 - NSF Division of Physics, Elementary Particle Physics Program
 - function together through a Joint Oversight Group (JOG)
- ◆ US CMS S&C Project profits from close coor. b/w DOE and NSF
 - receives funding from DOE and NSF
 - involves close collaboration b/w DOE and NSF funded groups
- ◆ JOG
 - establishes programmatic guidance and direction,
 - coordinates DOE and NSF policy and procedures
 - oversees the project
- ◆ US LHC Program Office, led by LHC project manager
 - provides day-to-day management and support for US participation in LHC program, see Construction Project PMP



Relation to Other Entities, cont'd

► Relation to the Fermilab Computing Division

- ◆ Fermilab Computing Division
 - home of US CMS S&C Project within Fermilab
 - L1PM and L2PM for UF members of CD
 - Project Office resides within CD
 - Staff for T1 Regional Center are members of CD
 - Most of Staff for UF are members of CD
- ◆ Head of CD member of US ASCB
- ◆ CD Manpower is accounted for in US CMS S&C Project
- ◆ Project leverages CD expertise, infrastructure, procedures





Summary On External Relations

- The Project is overseen by and reports to the PMG
- Formal relationship to other entities
 - especially to CMS and Fermilab CD --- through
- US Advisory Software and Computing Board US ASCB
- Chair of PMG conducts “Blucher reviews”(SCOP)
- Funding Agencies conduct these “DOE/NSF reviews”



Scope of US CMS S&C Project

The US CMS Software and Computing Project

- ◆ Core Application Software (CAS)
- ◆ User Facilities (UF), including T1 and T2 centers

→ **UF and CAS subprojects managed by a Level2 Project Manager each**

Networking support

- ◆ CERN--US/Fermilab
- ◆ Internal to US

Reconstruction and Detector Software

Physics Analysis

- These are closely related but are dealt with outside of this particular project as an “extended project” or as “related activities”



Project Plan Emerging

- **Acting L1 and L2 managers have worked with the US ASCB to create a project plan for the Software and Computing Project**
 - ◆ UF WBS document
 - ◆ UF Hardware and Material Costs document
 - important real world input from local FNAL/Run II experts!!
 - ◆ CAS WBS Dictionary document
 - ◆ all these summarized in Project Overview document you'll find these documents in the handouts
- **Subject to approval by the PMG**
- **In defining the Plan: US ASCB interface to US CMS**
 - ◆ setting requirements for the project plan
 - ◆ helping to develop any overall policies associated with it
 - ◆ deal w/ matters of major impact on physics eventually brought to US CMS CB
 - ◆ project input and feedback



Project Plan Overall Structure: WBS

ID	WBS	Task Name	2000 1 2 2	2001 1 2 1	2002 1 2 1	2003 1 2 1	2004 1 2 1	2005 1 2 1	2006 1 2 1
1	WBS	US CMS Software and Computing Project							
2	WBS.1	1 User Facility Subproject							
3	WBS.1.1	1.1 Tier 1 Regional Center							
99	WBS.1.2	1.2 System and User Support							
120	WBS.1.3	1.3 Operations and Infrastructure							
134	WBS.1.4	1.4 Tier 2 Regional Centers							
190	WBS.1.5	1.5 Networking							
205	WBS.1.6	1.6 Computing and Software R&D							
264	WBS.1.7	1.7 Detector Construction Phase Computing							
283	WBS.1.8	1.8 Support for FNAL based computing							
302	WBS.2	2 Core Application Software							
303	WBS.2.1	2.1 Software Architecture							
317	WBS.2.2	2.2 Interactive Graphics and User Analysis							
338	WBS.2.3	2.3 Distributed Data Management and Processing							
356	WBS.2.4	2.4 User Support							
365	WBS.3	3 Project Office							
366	WBS.3.1	3.1 Resource and Budget Management							
367	WBS.3.2	3.2 System Engineering							
368	WBS.3.3	3.3 Review Preparation and Oversight							
369	M	Milestones							



Nov 14, 2000

US CMS S&C Project Organization

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Project Plan

- **Approach to scope definition UF and CAS different**
- **UF approach to Project Plan:**
 - ◆ **uses bottom up approach**
 - starts with requirements for CMS contribution + US CMS additional requirements
 - estimates technology and resources needed
 - does cost estimations using “Moore’s Law”
 - also comparison with top down approach, Run II experience
 - ◆ **results in detailed effort and cost estimations for UF**
 - documented in two papers, for labor and cost
 - **CAS uses level of effort to CMS software project**
 - ◆ canonical 25% contribution
 - ◆ plus support effort to US CMS users for core software



“Rolling” Planning for CAS

► **CAS Scope is defined as a 25% Level of Effort to CMS Software Project**

- ◆ justified by relative size of US CMS and the software expertise and leadership roles of US CMS groups and individuals
 - ◆ the CMS software effort determines resource profile
 - ◆ US CMS CAS planning is detailed and concrete
 - ◆ however it is NOT bottom up
 - no mass production but each piece of software distinct
 - continuous need for functional software for US CMS projects which cannot be planned for inside the scope this project
 - needs and technologies are continuously evolving
- ## ► **Resource planning in “rolling” approach**
- ◆ specific tasks and responsibilities are assigned to US CMS
 - ◆ fully resource loaded WBS for detailed planning and tracking
 - for this FY tasks defined and resource loaded to level 5 or 6
 - for the next FY rolled up to level 4 or 5
 - for the rest of project rolled up to level 3



CAS Subproject Scope

→ Current US CMS contribution and leadership in

- ◆ Software Architecture
- ◆ Interactive Analysis
- ◆ Distributed Data Management and Processing
- ◆ In addition User Support on CAS to US physicists

→ Overall effort

FY	2001	2002	2003	2004	2005	2006
CAS FTE request	10	11	12	13	13	13

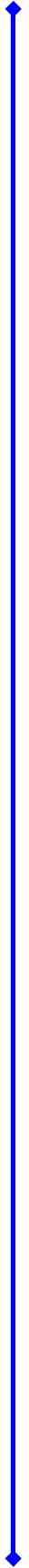
- ◆ Overall constraints on US CMS cost exposure needs to be defined in agreement with all parties
- ◆ MOUs are under discussion in the Hoffmann Review of LHC Computing, reporting to the CERN Resource Review board



Project Management of Cost and Schedule

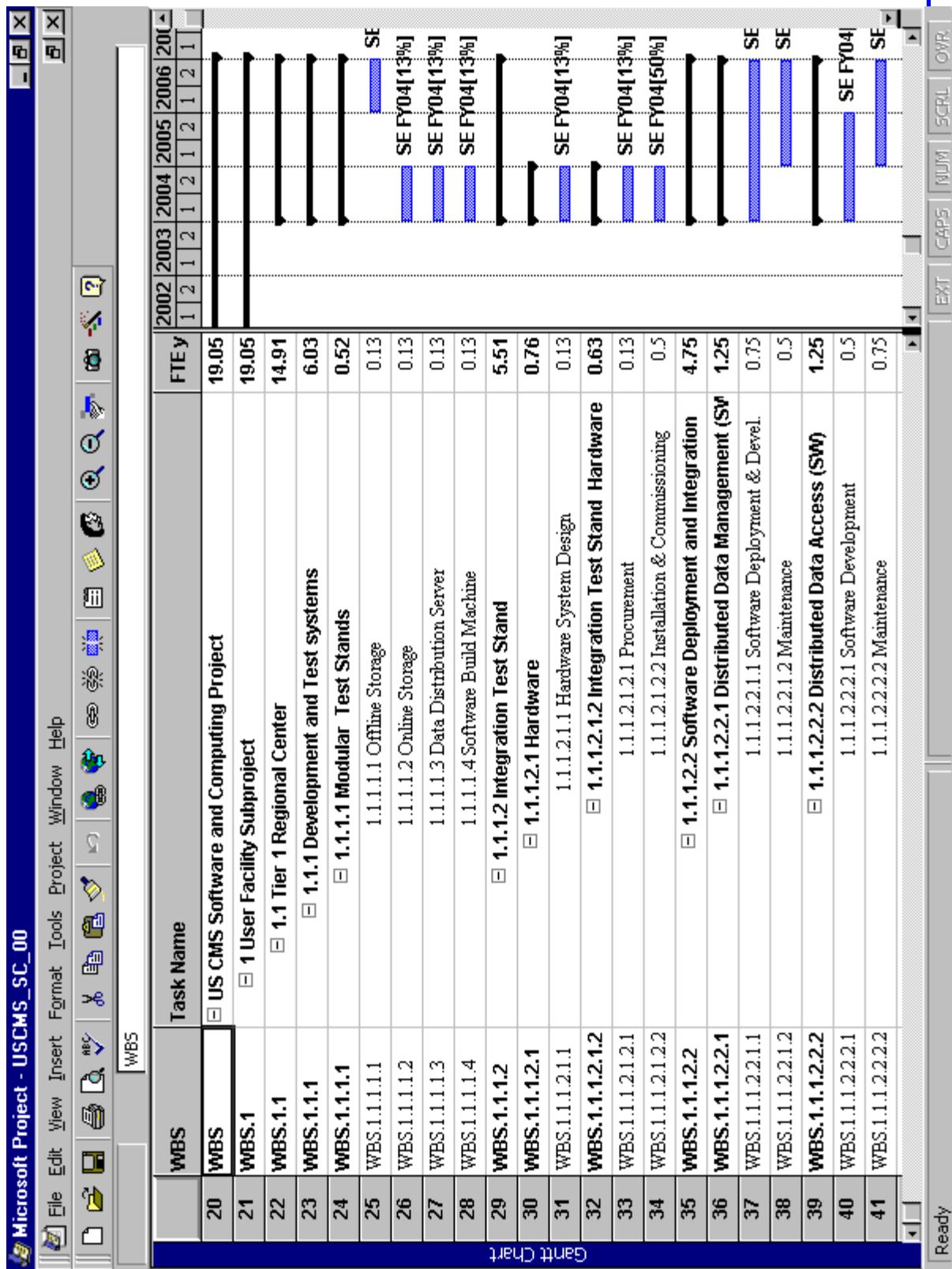
- **Cost Baseline to be established when approved by JOG and to be controlled by Project Office**

- ◆ Baseline of cost and schedule in FY2001 dollars
- ◆ included are procurement, assembly and installation of all technical components, software engineering, support and project management
- ◆ escalation rates based on assumed annual escalation rate given by guidance from DOE, currently 3%
- ◆ changes in costs, technical requirements, schedules, plans to be treated as variances to the baseline





Resource loaded WBS down to level 7





Schedule

► **The Schedule: contains all the tasks and resources**

- ◆ currently documented in WBS documents for UF and CAS
- ◆ milestones will be made more detailed

► **Resource loaded WBS w/ milestones**

- ◆ Project file will contain all relevant project information
- ◆ All resources, material and equipment and labor are defined at lowest level of WBS, typically level 7
- ◆ Resource and commitment profiles derived from resource loaded schedule
- ◆ profit from project management procedures and templates of US CMS construction project



Resource Allocation and SOWs

- **Annual Budget Request to Funding Agencies**
 - ◆ DOE and NSF make funds available on annual basis
- **L1PM reviews, negotiates, approves the SOW**
 - ◆ includes description of work to be performed
 - ◆ detailed planning, schedule, cost, milestones
 - ◆ cost recording and reporting
 - ◆ signed by L1PM, L2PM of subproject
 - ◆ at Institution by PI, Grants/Contracts Officer, Procurement/Personnel Responsible
- **funds released to institutions (including Fermilab)**
 - ◆ PO will be responsible for administration of funds
 - ◆ support from CD budget office
- **general responsibilities, like deployment of T2 centers to be supported by MOUs**



Management Reserve

► **Management Reserve of 10% requested**

- ◆ React to changing requirements
- ◆ Resolve unforeseen difficulties
- ◆ Take advantage of purchase or hiring opportunities
- ◆ Deal with scope and schedule changes
- ◆ Cover cost increases

► **Allocation of Management Reserve**

- ◆ 10% of yearly budget held by L1PM
- ◆ released during the FY according to performance and needs
- ◆ a scheme of reporting/change control will be put in place
- ◆ The Management Reserve will be allocated subject to the formal change control procedure.



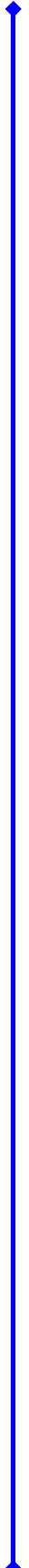
Reporting and Reviewing

- **L2 managers collecting and preparing regular reports**
 - ◆ L2PMs will receive budget and efforts reports from US CMS institutions
 - ◆ project actual costs are collected, performance reports prepared
 - ◆ updating of effort and budget in project file using project templates to keep project file up to date
- **Regular (quarterly) reporting to be done on the sub-project level (level 3) to PMG**
 - ◆ reports to PMG meetings, and to agency project manager
- **US CMS gets informed regularly**
 - ◆ reports at US ASCB meeting + other CMS bodies, SCTB, SCB
- **PMG and DOE/NSF conduct peer reviews**
 - ◆ standing reviews, propose 1 full review + 1 status report / year
 - ◆ detailed recommendations from reviewers to PMG/JOG and the project



Project Office for Management Support

- **Project Office will give technical help for managing the project**
 - ◆ **setup of necessary procedures for project management**
 - maintaining central project file, resource loaded WBS and schedule
 - prepare templates and macros
 - ◆ **support for management tasks and administrative help**
 - analysis of cost and performance reports
 - preparation of reports
 - help with review preparations





Project Office Staff

- **Staffed to give technical and administrative Support for Project Management**
- **One project engineer and administrative support**
 - ◆ Coordinating the management activities at all levels
 - ◆ Overseeing purchases
 - ◆ Establishing MoU's, SOW's
 - ◆ Preparing for Reviews
 - ◆ Tracking budget
 - ◆ Tracking schedule and progress
- **Budget tracking and reporting support from CD budget office**
- **Plan to hire project engineer this year**



Controlling Change

- **Project Organization will have to cope with changes**
 - ◆ requirements not completely defined
 - computing requirements for T1, use cases for CAS
 - ◆ cost extrapolations not completely safe
 - high risk due to large extrapolation
 - ◆ schedule will be adopted to CMS and external requirements
- **The L1PM will control these changes**
 - ◆ requirements, costs, and schedule
 - ◆ in consultation and agreement, as appropriate
 - with the PMG and CMS through US ASCB and CB
 - ◆ detailed change control thresholds will be established
 - technical changes,
 - schedule changes,
 - cost changes.
 - ◆ values of thresholds and approval authority in each area at each threshold will be set when project baseline is established.



Project Management in Place Soon

► **Level 1 Project Manager**

- ◆ LATBauerdick's appointment Confirmed by JOG 06/00
- ◆ will start office after this review, Monday Nov 20, 2000 8:00...

► **Level 2 Project Managers**

- ◆ will be appointed by L1PM in consultation with the US ASCB and with the concurrence of the PMG
- ◆ L1PM will start the process immediately
- ◆ assignment should happen within 30 days

► **Level 3 Project Managers**

- ◆ L2PMs will define L3 projects and propose the L3 managers subject to the approval of the L1PM
- ◆ each T2 center is a L3 subproject under L2 UF project
- ◆ each T2 center will appoint a manager - concurring with UFL2

► **Deputy Managers**



Summary

- **US CMS S&C Project scope, schedule and cost are well defined**
- **We have defined and documented the Project Plan**
- **A detailed and resource-loaded WBS and Schedule exists, which has milestones, costs and labor**
- **Reporting, Oversight and Reviewing is in place**
- **We have strong Project Team and Project Management**
- **We have a strong Project Organization in place to support the project**
- **The US CMS Software and Computing Project is ready to be baselined!**